DEPARTMENT OF EARTH AND PLANETARY SCIENCES

Mission Statement

The Department of Earth and Planetary Sciences is dedicated to advancing scientific knowledge in geosciences, especially in general geology, earth system and climate, environmental geoscience, and water science. The Department finds solutions to complex multidisciplinary problems involving earth and planetary sciences.

General Information

The Department of Earth and Planetary Sciences at The University of Texas at San Antonio has academic expertise, research excellence, and student success across the fields of earth sciences, environmental geosciences, geoinformatics, and planetary sciences. Our research laboratories and facilities provide both undergraduate and graduate students with the opportunity to acquire knowledge and practical skills in multiple areas of geosciences. These laboratories include Chemical Hydrology and Mass Spectrometry Lab, Computational and Geographic Information Science (GIS) Labs (two), Hydrogeology Facility, Heat and Mass Transfer & Experimental Rheology Lab, Micropaleo and Stratigraphy Facility, Ocean Science Lab, Remote Sensing and Geoinformatics Lab, River Science Lab, Rock Preparation Facility, Sedimentary Geology and Mineralogy Lab, Snow and Ice Geophysics Lab. The department faculty also leads a university-wide collaborative Center and Institute: NASA MIRO Center for Advanced Measurements in Extreme Environments (CAMEE (http://www.utsa.edu/NASA-CAMEE/)) and Institute for Water Research, Sustainability and Policy (IWRSP (http://www.utsa.edu/iwrsp/)).

Degrees

The Department of Earth and Planetary Sciences offers a Master of Science degree in Geosciences, a Master of Science degree in Geoinformatics, and a Certificate of Professional Development in Geographic Information Science. Department faculty also participate in the Ph.D. program in Environmental Science and Engineering administered by the School of Civil and Environmental Engineering, and Construction Management (https://catalog.utsa.edu/graduate/engineeringintegrateddesign/civilenvironengr-constructionmgt/).

The Master of Science (M.S.) degree in Geosciences provides opportunities to prepare for careers in geosciences and pursue successful studies in graduate school. The M.S. degree in Geosciences thesis option requires 30 credit hours: 8 hours of required coursework, 16 hours of electives, 6 hours of master's thesis, and the comprehensive exam. The M.S. degree in Geosciences non-thesis option requires 36 credit hours: 11 hours of required coursework, 25 hours of electives, and the comprehensive exam.

The Master of Science (M.S.) degree in Geoinformatics provides opportunities to prepare for careers in geoinformatics, geographic information science (GIS), and remote sensing and to pursue successful studies in graduate school. The M.S. degree in Geoinformatics thesis option requires 31 credit hours: 16 hours of required coursework, 9 hours of electives, 6 hours of master's thesis, and the comprehensive exam. The M.S. degree in Geoinformatics non-thesis option requires 31 credit hours: 16 hours of required coursework, 15 hours of electives, and the comprehensive exam.

The Graduate Certificate of Professional Development in Geographic Information Science provides opportunities to learn and combine the fundamental tools of remote sensing and GIS programming. The Graduate Certificate in GIS requires 15 credit hours of specific coursework.

Faculty in the Department of Earth and Planetary Sciences supervise students in the Environmental Sciences and Engineering doctoral program administered by the School of Civil and Environmental Engineering, and Construction Management (https://catalog.utsa.edu/graduate/engineeringintegrateddesign/civilenvironengr-constructionmgt/). The program offers advanced training in research and environmental sciences with an emphasis on natural resources, especially water, land, and air resources. It requires 60 credit hours for master-holding students or 75 credit hours for bachelor-holding students.

Educational Objectives

Upon graduation, students in the Department of Earth and Planetary Sciences programs will be able to:

- Communicate advanced geologic knowledge, data, and interpretations of their research in both written and oral presentations to their supervisory committee, the department's community of geoscientists, and the public (**Communication**).

Students in the M.S. in Geosciences and Ph.D. in Environmental Science and Engineering degrees, upon graduation, will be able to:

- Demonstrate advanced specialized geologic knowledge in their chosen sub-discipline by clearly communicating this knowledge and its significance and merits to both specialists and non-specialists within their geologic sub-discipline (**Knowledge in Sub-discipline)**, such as:
  - Water: hydrogeology and aqueous geochemistry;
  - Sedimentary environments and paleoenvironments: chemostratigraphy, biostratigraphy, paleontology, fluvial geomorphology, structural geology;
  - Remote sensing of climate change: polar science, ice-ocean-atmosphere, oceanography;
  - Planetary sciences: volcanology, astro-mineralogy, astrobiology, planetary surface processing and mapping.
- Conduct advanced geologic literature research, recognize errors and biases in data, and synthesize and critique information from primary geologic literature in written and oral formats (**Research and Analysis**).
- Apply advanced theoretical, conceptual, and observational knowledge to analyze physical, chemical, or biological processes and interpret their interconnection to complex geologic problems encountered in advanced graduate-level coursework and original research (**Complex Problem Solving and Critical Thinking**).

Upon graduation, students in the M.S. in Geoinformatics degree will be able to:

- Create digital maps that portray human and/or physical phenomena on Earth and other planets (**Geospatial Mapping**);
- Apply advanced data science techniques to extract geophysical parameters from satellite-based image series (**Geospatial Data Science**);

- Develop geospatial science and technology capabilities to solve problems, conduct research, and assume leadership roles in industry, government, and/or academia (**Geospatial problem solving and Leadership**).

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- M.S. in Geoinformatics (p. 3)
- Ph.D. in Environmental Science and Engineering (p. 5)

Master of Science Degree in Geosciences

The Master of Science degree program in Geosciences offers opportunities for advanced study and research designed to prepare students for roles in industry, government, research institutes, or educational institutions. In addition to the oil and gas and mining industries, which employ many geoscientists, this degree prepares you equally well for a career in the environmental industry, engineering firms, water utility companies, state and local regulatory agencies, federal government agencies, including the U.S. Geological Survey, the National Park Service, NASA, or as an educator at the K-12 or university level. Completing this degree provides part of the credentials to qualify as a licensed Professional Geoscientist to advance into management in environmental companies.

A master's degree in Geosciences can set you on a path to help solve problems facing society. For example, as the planet pivots to green energy, the need for different classes of mineral resources is exploding, and so is the demand for exploration geoscientists to ensure we have the necessary resources. Geoscientists monitor and maintain safe surfaces and groundwater so that cities can grow and wild rivers can thrive to support the ecosystems that we depend on. We ensure that contaminants do not escape from active industrial sites and determine the most effective way to remediate polluted sites of the past. To understand past climates and to better model future changes geoscientists collaborate with climate scientists.

Program Admission Requirements

In addition to satisfying the University-wide graduate admission requirements, applicants are expected to have completed an undergraduate degree in the geosciences or a bachelor's degree in chemistry, physics, mathematics, computer science, life sciences, or engineering with sufficient coursework in the geosciences. Students whose undergraduate preparation is deficient but who meet the minimum University standards for admission may be conditionally admitted and required to complete specific courses as conditions of admission. If such courses are listed as deficiencies, they will not count toward the graduate degree. Applicant's evaluations will be considered on a case-by-case basis.

Applicants must submit two letters of recommendation from persons familiar with the applicant's academic record, a personal statement of research interest, and undergraduate transcripts. All supporting documents must be submitted to Graduate Admissions. Incomplete applications will not be considered until all required items are in an applicant's file.

Applicants whose native language is not English must submit scores from the Test of English as Foreign language (TOEFL) or the International English Language Testing Systems (IELTS) and must meet the minimum University-wide requirements.

The Graduate Faculty and Graduate Advisor of Record (GAR) will be responsible for recommending acceptance into the program.

The GAR will take the lead in advising students until an academic advisor is identified. A limited number of teaching assistantships are available, and the application form can be found on the departmental webpage. Individual faculty members may have opportunities for research assistantships and should be contacted directly.

Graduate Committee

As specified by University regulations, candidates for the Master of Science degree must have a Graduate Committee. The Committee will be chaired by the student's academic advisor and will consist of a minimum of two other members. Each student must decide if they are going to complete the thesis or non-thesis option within the first year of study —preferably within the first semester—because that will determine the faculty membership of the committee appointed. The Committee should be appointed once an academic advisor and research topic have been determined. University rules for the supervising committee must be followed. Only tenured or tenure-track faculty members can chair these committees, and no more than one member can be a fixed-term-track faculty member or be from another institution.

Comprehensive Examination

Candidates for the Master of Science degree must pass a comprehensive examination administered by their Graduate Committee. The student should schedule this examination for the semester the degree requirements are to be completed. The student's Graduate Committee will determine the content of the examination, but it typically consists of academic material that the student is expected to have mastered during his or her course of study. For a Thesis student, the thesis defense is treated as a comprehensive examination. For a Non-Thesis student, the comprehensive examination is a written exam. The examination may only be taken twice. If it is not passed the first time, it may be scheduled again in the following semester.

Thesis Option in Geosciences

Degree Requirements

The Master of Science degree in Geosciences requires the successful completion of a minimum of 30 semester credit hours (exclusive of coursework or other study required to remove academic or admission deficiencies).

Thesis Option Requirements

All candidates for the Master of Science in Geosciences with Thesis Option must complete a minimum of 30 semester credit hours of the following:

Code	Title	Credit Hours
A. 8 semester credit hours of required courses:		8
GEO 5103	Current Topics in the Geosciences	
GEO 5113	Research Design in the Geosciences	
GEO 5991	Graduate Seminar in Geosciences (repeated for a total of 2 hours)	
B. A minimum of 16 semester credit hours of electives in consultation with Graduate Advisor of Record:		16

A minimum of 16 hours of approved graduate credit is required. This may include 6 hours total of any combination of GEO 6953 Independent Study and GEO 5973 Directed Research. Under special circumstances, students may take up to 6 semester credit hours of upper-division undergraduate coursework in the College of Sciences or the Klesse College of Engineering and Integrated Design with approval of the Graduate Advisor of Record. If approved to enroll in undergraduate coursework, students must complete the "Permission for Enrolling in Undergraduate Courses While a Graduate" form and receive all approvals.		
C. Master's Thesis:		6
GEO 6983	Master's Thesis (repeated for a total of 6 hours)	
Candidates must submit a research proposal to the student's Academic Advisor and Committee no later than the beginning of the third semester of graduate work.		
D. Comprehensive Examination:		
Candidates for the Master of Science degree electing the Thesis Option must also pass a final oral comprehensive examination in which they successfully defend their thesis before their Graduate Committee. The thesis defense will take two to three hours to complete. The thesis defense is normally scheduled in the last semester before the degree requirements are to be completed. Part of the thesis defense will be a public presentation in an open, advertised forum.		
Total Credit Hours		**30**

Non-Thesis Option in Geosciences

Degree Requirements

The Master of Science degree in Geosciences requires the successful completion of a minimum of 36 semester credit hours (exclusive of coursework or other study required to remove academic or admission deficiencies).

Non-Thesis Option Requirements

A Non-Thesis Option is available for those who want the opportunity to earn the Master of Science degree in Geosciences primarily through organized coursework. Non-Thesis students should consult the Graduate Advisor of Record on their program of study during the first semester of residence. Candidates are required to complete a minimum of 36 semester credit hours of the following:

Code	Title	Credit Hours
A. 11 semester credit hours of required courses:		11
GEO 5103	Current Topics in the Geosciences	
GEO 5113	Research Design in the Geosciences	
GEO 5973	Directed Research	
GEO 5991	Graduate Seminar in Geosciences (repeated for a total of 2 semester credit hours)	
B. A minimum of 25 semester credit hours of electives in consultation with the Graduate Advisor of Record		25
An additional 25 hours of graduate credit as approved by the Graduate Advisor of Record is required. This may include no more than 6 hours total of any combination of GEO 6953 Independent Study and GEO 5973 Directed Research. Under special circumstances, students may take up to 6 semester credit hours of approved upper-division undergraduate coursework within the College of Sciences or the Klesse College of Engineering and Integrated Design with approval of the Graduate Advisor of Record. If approved to enroll in undergraduate coursework, students must complete the "Permission for Enrolling in Undergraduate Courses While a Graduate" form and receive all approvals.		
C. Comprehensive Examination:		
GEO 6961	Comprehensive Examination	
Enrollment in GEO 6961, Comprehensive Examination, will be required in the semester the comprehensive examination is taken, if registered for no other courses that semester.		
Candidates are required to pass a written comprehensive examination that covers several major areas of geosciences. This examination is taken after the student has completed at least 30 semester credit hours of coursework. If GEO 6961 Comprehensive Examination is taken, it does not contribute toward the 36-semester-credit-hour minimum.		
Total Credit Hours		**36**

Master of Science Degree in Geoinformatics

The Master of Science degree program in Geoinformatics offers opportunities for advanced study and research designed to prepare students for roles in industry, government, research, and/or academic institutions. The educational objective of this program is to produce graduates who are capable of applying geospatial technology for conducting original research in industry or academia, as well as assuming a leadership role in their chosen employment field. This is a multidisciplinary program administered by the Department of Earth and Planetary Sciences. It encompasses faculty and facilities from the College of Sciences, College of Liberal and Fine Arts, Klesse College of Engineering and Integrated Design, and College for Heath, Community and Policy, as well as individual faculty from other UTSA departments.

Program Admission Requirements

In addition to satisfying the University-wide graduate admission requirements, applicants are expected to have completed either a Bachelor of Science degree, with emphases in geological, biological, physical, environmental, or computational sciences, or a Bachelor of Arts degree, with emphases in geography, social sciences, humanities, or business. Five required background classes or equivalents are: algebra (MAT 1073), computer programming (CS 1063), physics (PHY 1603 or PHY 1943), statistics (STA 1053), and world geography (GES 1023). Students whose undergraduate preparation is deficient but who meet the minimum University standards for admission may be conditionally admitted and required to complete specific courses as conditions of admission. If such courses are listed as deficiencies, they will not count toward the graduate degree. Background with GIS and/or remote sensing courses is a plus, but not required. Applicants' evaluations will be considered on a case-by-case basis.

Applicant must submit two letters of recommendation from persons familiar with the applicant's academic record, a personal statement of research or career interest, and undergraduate transcripts. All supporting

documents should be submitted through the Graduate Admissions website. Incomplete applications will not be considered until all required items are in an applicant's file.

Applicants whose native language is not English must submit scores from the Test of English as Foreign language (TOEFL) or the International English Language Testing Systems (IELTS) and must meet the minimum University-wide requirements.

The Geoinformatics Graduate Studies Committee, comprised of five graduate faculty members elected from the involved departments and colleges, and the Graduate Advisor of Record (GAR) will be responsible for recommending acceptance into the program. A limited number of teaching assistantships are available, and applications should be submitted to the Department Chair. Individual faculty members may have opportunities for research assistantships or research fellowships and should be contacted directly.

Graduate Committee

As specified by University regulations, candidates for the Master of Science degree must have a Graduate Committee. The Committee will be chaired by the student's academic advisor and will consist of a minimum of two other members. Each student must decide if they are going to complete the Thesis or Non-Thesis Option within the first year of study —preferably within the first semester—because that will determine the faculty membership of the committee appointed. The Committee should be appointed once an academic advisor and research topic have been determined. University rules for the supervising committee must be followed. Only tenured or tenure-track faculty members can chair these committees, and no more than one member can be a fixed-term-track faculty member or be from another institution.

Comprehensive Examination

Candidates for the Master of Science degree must pass a comprehensive examination administered by their Graduate Committee. The student should schedule this examination the semester the degree requirements are to be completed. The student's Graduate Committee will determine the content of the examination. The examination will consist of academic material that the student is expected to have mastered during the course of study. For a Thesis Option student, the thesis defense is treated as the comprehensive examination. The examination may only be taken twice. If it is not passed the first time, it may be scheduled again in the following semester.

Thesis Option in Geoinformatics

Degree Requirements

The Master of Science degree in Geoinformatics requires the successful completion of a minimum of 31 semester credit hours (exclusive of coursework or other study required to remove academic or admission deficiencies).

Thesis Option Requirements

All candidates for the Master of Science in Geoinformatics with Thesis Option must complete a minimum of 31 semester hours of the following:

Code	Title	Credit Hours
A. 16 semester credit hours of required courses:		16
One of the following:		
GEO 5033	Geographical Information Systems	
CE 5093	Geographic Information Systems (GIS)	
All of the following:		
GEO 5063	Applied Statistics for Geoinformatics	
GEO 6011	Seminar in Geospatial Science and Applications	
GEO 6053	Remote Sensing	
GEO 6513	Advanced GIS	
GEO 6533	Programming for Geospatial Application	
B. A minimum of 9 semester credit hours of electives in consultation with Graduate Advisor of Record:		9
An additional 9 semester credit hours of graduate credit as approved by the Graduate Advisor of Record is required, which includes a minimum of two prescribed courses in a candidate's substantive area of interest, from the following:		
ANT 6653	Spatial Techniques in Anthropology	
CE 5303	Hydrometeorology	
CS 5443	Database Management Systems	
CS 5573	Cloud Computing	
CS 5633	Analysis of Algorithms	
CS 6243	Machine Learning	
DEM 7093	GIS for Population Science	
DEM 7263	Spatial Demography	
ES 5023	Environmental Statistics	
GEO 6083	Remote Sensing Image Processing and Analysis	
GEO 5133	Atmospheric Science	
GEO 6093	Remote Sensing in Hydrology	
GEO 6543	Web GIS	
GRG 5003	Research Design and Spatial Analysis	
GRG 5443	Seminar in Critical GIS	
GRG 5653	Designing Better Maps: Seminar in GIS Cartography	
GRG 5913	Design and Management of Geographic Information Systems	
IS 5143	Information Technology	
IS 6703	Introduction to Data Mining	
IS 6733	Deep Learning on Cloud Platforms	
STA 5093	Introduction to Statistical Inference	
STA 5103	Applied Statistics	
STA 6863	Spatial Statistics	
URP 5233	GIS for Urban Studies	
Or other courses if course descriptions are appropriate.		
C. Master's Thesis:		6
GEO 6983	Master's Thesis (repeated)	
D. Comprehensive Examination		
Candidates for the Master of Science degree electing the Thesis Option must also pass a final oral comprehensive examination in which they successfully defend their thesis before their Graduate Committee. The thesis defense will take one to two hours to complete. The thesis defense is normally scheduled in the last semester before the degree requirements are to be completed. Part of the thesis defense will be a public presentation in an open, advertised forum.		
Total Credit Hours		**31**

Non-Thesis Option in Geoinformatics

Degree Requirements

The Master of Science degree in Geoinformatics requires the successful completion of a minimum of 31 semester credit hours (exclusive of coursework or other study required to remove academic or admission deficiencies).

Non-Thesis Option Requirements

The Non-Thesis Option is available for those who want the opportunity to earn the Master of Science degree in Geoinformatics primarily through organized coursework. Non-thesis students should consult the Graduate Advisor of Record on their program of study during the first semester of residence. In order to graduate, the candidate is required to pass a final oral comprehensive examination conducted by the candidate's Graduate Committee. The examination will be based on a project that applies geospatial technology to the candidate's area of specialty and fundamental knowledge of geospatial science and technologies.

Candidates are required to complete a minimum of 31 semester credit hours of the following:

Code	Title	Credit Hours
A. 16 semester credit hours of required courses:		16
One of the following:		
CE 5093	Geographic Information Systems (GIS)	
GEO 5033	Geographical Information Systems	
All of the following:		
GEO 5063	Applied Statistics for Geoinformatics	
GEO 6011	Seminar in Geospatial Science and Applications	
GEO 6053	Remote Sensing	
GEO 6513	Advanced GIS	
GEO 6533	Programming for Geospatial Application	
B. A minimum of 15 semester credit hours of electives in consultation with Graduate Advisor of Record:		15
An additional 15 hours of graduate credit as approved by the Graduate Advisor of Record is required, which includes a minimum of two prescribed courses in a candidate's substantive area of interest, from the following:		
ANT 6653	Spatial Techniques in Anthropology	
CE 5303	Hydrometeorology	
CS 5443	Database Management Systems	
CS 5573	Cloud Computing	
CS 5633	Analysis of Algorithms	
CS 6243	Machine Learning	
DEM 7093	GIS for Population Science	
DEM 7263	Spatial Demography	
ES 5023	Environmental Statistics	
GEO 5133	Atmospheric Science	
GEO 6083	Remote Sensing Image Processing and Analysis	
GEO 6093	Remote Sensing in Hydrology	
GEO 6543	Web GIS	
GEO 6953	Independent Study	
GRG 5003	Research Design and Spatial Analysis	
GRG 5443	Seminar in Critical GIS	
GRG 5653	Designing Better Maps: Seminar in GIS Cartography	
GRG 5913	Design and Management of Geographic Information Systems	
IS 5143	Information Technology	
IS 6703	Introduction to Data Mining	
IS 6733	Deep Learning on Cloud Platforms	
STA 5103	Applied Statistics	
STA 6863	Spatial Statistics	
STA 6973	Special Problems	
URP 5233	GIS for Urban Studies	
Or other courses if course descriptions are appropriate.		
Total Credit Hours		**31**

Doctor of Philosophy Degree in Environmental Science and Engineering

UTSA offers a graduate-studies program leading to the Ph.D. degree in Environmental Science and Engineering. This program is administered by the School of Civil and Environmental Engineering and Construction Management. Most of the participating graduate faculty are in the College of Sciences (including Department of Earth and Planetary Sciences) and Klesse College of Engineering and Integrated Design (School of Civil and Environmental Engineering, & Construction Management); additional faculty in this interdisciplinary program are from other colleges. Please refer to the School of Civil and Environmental Engineering, & Construction Management (https://catalog.utsa.edu/graduate/engineeringintegrateddesign/civilenvironengr-constructionmgt/#degreestext) section of this catalog for details about this program.

Graduate Certificate of Professional Development in Geographic Information Science

The purpose of the Graduate Certificate of Professional Development in Geographic Information Science is to train individuals from a broad range of academic disciplines to be competent users of Geographic Information Science and the related tools of Remote Sensing and GIS programming. Although the program is generally oriented toward professionals in geosciences, individuals with business, social science, medical, engineering, computer science, criminal science, or education backgrounds will benefit from this professional certificate. Individuals completing this certificate will gain a practical and hands-on knowledge of Geospatial Science. All courses taken in the Graduate Certificate of Professional Development in Geographic Information Science program may be applied toward a master's degree in Geoinformatics, Geosciences, or Environmental Science, a doctoral degree in Environmental Science and Engineering, or other graduate degrees with approval of the Graduate Advisor of Record of the degree program.

Description of Certificate Program

The Graduate Certificate of Professional Development in Geographic Information Science is a 15-hour program. Degree-seeking or special graduate students from any discipline at UTSA are allowed to complete the program. Candidates for the certificate should ideally complete the program within one year, but not more than two years. Students will receive program guidance from the GIS Certificate Advisor of Record.

Certificate Program Requirements

To complete the certificate program, students must complete 15 semester credit hours of graduate courses addressing Geographic Information Science and Technology as follows:

Code	Title	Credit Hours
A. 3 hours selected from the following:		3
ANT 6653	Spatial Techniques in Anthropology	
CE 5093	Geographic Information Systems (GIS)	
DEM 7093	GIS for Population Science	
GEO 5033	Geographical Information Systems	
GRG 5913	Design and Management of Geographic Information Systems	
B. 6 hours selected from the following:		6
GEO 5063	Applied Statistics for Geoinformatics	
GEO 6053	Remote Sensing	
GEO 6083	Remote Sensing Image Processing and Analysis	
GEO 6093	Remote Sensing in Hydrology	
GEO 6523	GIS for Water Resources	
GEO 6543	Web GIS	
C. 6 hours of required courses:		6
GEO 6513	Advanced GIS	
GEO 6533	Programming for Geospatial Application	
Total Credit Hours		**15**

Geology (GEO) Courses

GEO 5013. Volcanology. (3-0) 3 Credit Hours.
Prerequisite: GEO 3043 or consent of instructor. A survey of volcanoes and volcanic processes, including historically important volcanic erupt ions and the prediction and mitigation of volcanic hazards. Field trips may be required. This course has Differential Tuition. Course Fee: GS01 $90.

GEO 5023. Big Data Analysis for Extreme Environments. (3-0) 3 Credit Hours.
This course will touch on three basic aspects of data science and technology: geospatial data, data assimilation and modeling, and cloud computation and dig data analytics. This course has Differential Tuition. Course Fee: GS01 $90.

GEO 5033. Geographical Information Systems. (2-3) 3 Credit Hours.
Application of the computer to environmental planning and management problems through a Geographical Information System (GIS). Using the computer as a mapping device for query, analysis, creation and display of spatially related data. Additional topics include using the Global Positioning System (GPS) for data acquisition. (Same as CE 5293. Credit cannot be earned for both CE 5293 and GEO 5033.) This course has Differential Tuition. Course Fee: GS01 $90.

GEO 5043. Introduction to Earth System Science and Remote Sensing. (3-0) 3 Credit Hours.
This course is designed for students in sciences or engineering to get basic knowledge about the earth system and some compelling science problems related to ice, snow, water, atmosphere, and ocean. The second part of the course will include some basic knowledge of remote sensing and how different remote sensing technology can be used to sense these different types of earth environments. This course has Differential Tuition. Course Fee: GS01 $90.

GEO 5063. Applied Statistics for Geoinformatics. (3-0) 3 Credit Hours.
Prerequisite: CS 1063, MAT 1073, and STA 1053, or consent of instructor. This is a practical course covering various statistical methods used in data preparation and analysis of geospatial data. Topics include mapping, data distributions, scatter plot comparisons, correlation analysis, uncertainly estimates, among others. Principal component analysis or geospatial data will also be covered. All course materials will be taught using the MATLAB programming language and presented in the form of problem sets. This course has Differential Tuition. Course Fee: GS01 $90; IUE1 $15.

GEO 5073. Mountain Environments and Climate Change. (3-0) 3 Credit Hours.
Prerequisite: ES 2113, GEO 2113 or GEO 3343, or consent of instructor. In-depth survey on current scientific questions and methods applied to study mountain environments, with a special focus on glaciers, snow, permafrost and streamflow. Application of remote sensing, GIS, modeling, and fieldwork techniques commonly utilized to study these regions. This course has Differential Tuition. Course Fee: GS01 $90.

GEO 5103. Current Topics in the Geosciences. (3-0) 3 Credit Hours.
Prerequisite: Graduate standing in geosciences or consent of instructor. Evaluation of current research trends and methodology in the geosciences and introduction to research project development. Elements of project management will also be covered. This course has Differential Tuition. Course Fee: GS01 $90.

GEO 5113. Research Design in the Geosciences. (3-0) 3 Credit Hours.
Prerequisite: GEO 5103 or consent of instructor. This course focuses on the development of research projects with a focus on methodology and data analysis. Elements of project management will also be covered. This course has Differential Tuition. Course Fee: GS01 $90.

GEO 5123. Climate Change: Past, Present, Future. (3-0) 3 Credit Hours.
An introduction to the Earth's climate system using real-world environmental data. Climate change is investigated with proxy records of the past, direct observations of the present, and climate model simulations of the future to understand both natural and human effects. The course also addresses how energy use and policy impacts climate change as well as how society is affected by it. Generally offered: Spring (online). This course has Differential Tuition. Course Fee: GS01 $90.

GEO 5133. Atmospheric Science. (3-0) 3 Credit Hours.
Introduction to atmospheric sciences and the dynamic world of weather using real-world current environmental data. The course covers the composition and structure of the atmosphere, the flow of energy into, through, and out of the atmosphere, and the resulting motions from local to global scales. The impact of weather on humans, particularly severe weather, is studied, emphasizing basic physical principles of atmospheric phenomena. Analysis methods are introduced as the students study current meteorological data delivered via the Internet. (Same as GEO 3003. Credit cannot be earned for both GEO 3003 and GEO 5133.) Generally offered: Fall. This course has Differential Tuition. Course Fee: GS01 $90.

GEO 5183. Geochemistry. (2-3) 3 Credit Hours.
Prerequisite: GEO 1103, GEO 1111, CHE 1103, CHE 1121, MAT 1093, or consent of instructor. A survey of geochemical processes and the distribution of elements in the earth. Application of geochemical methods and data to the solution of geologic problems. Includes geochemical laboratory experiments and use of analytical equipment. Incorporates use of standard computer software for analysis of geochemical data and graphing of results. Students taking this class will learn to describe the role that modern geochemistry plays in all aspects on Earth Sciences, solve geochemical problems using geochemical datasets, and explain geochemical processes that take place at depth and at the surface of our planet. (Formerly GEO 3374. Credit cannot be earned for both GEO 3374 and GEO 5183.) Generally offered Fall. This course has Differential Tuition. Course Fee: GS01 $90.

GEO 5213. Aqueous Geochemistry. (3-0) 3 Credit Hours.
Prerequisite: GEO 3373, or consent of instructor. This course will facilitate understanding in detail the fundamental (primarily thermodynamic) controls on the composition of natural waters and the response of natural waters to variations in various physicochemical parameters. Characterization of dissolved organic matter in natural waters will be introduced. This course will explore applications to environmental problems like contaminants migration in waters (ground waters, surface waters), weathering, etc., and students will be given the opportunity to learn to solve numerical problems related to the behavior of chemical components in natural waters and gain familiarity with simple analytical techniques for the characterization of natural waters. This course has Differential Tuition. Course Fee: GS01 $90.

GEO 5403. Fluvial Processes and Deposits. (3-0) 3 Credit Hours.
Prerequisite: GEO 4113, or GES 3723, or consent of instructor. An in-depth examination of the interface between fluvial geomorphology and sedimentology. This course has Differential Tuition. Course Fee: GS01 $90.

GEO 5413. River Science. (3-0) 3 Credit Hours.
Prerequisite: Graduate standing in biology, environmental science, geology, or civil engineering, or consent of instructor. An in-depth examination of river sediment transport principles. Topics include water and sediment supply, sediment dynamics, river morphology, and channel instability. Field trips may be required. (Formerly GEO 5414, CE 5323, and CE 5653. Credit can be earned for only one of the following: CE 5323, CE 5653, GEO 5414, or GEO 5413.) This course has Differential Tuition. Course Fee: GS01 $90; LRS1 $46.20; STSI $21.60.

GEO 5453. Natural Hazards. (3-0) 3 Credit Hours.
Prerequisite: GEO 1103, and PHY 1623 or PHY 1943. Natural hazards include tectonic (e.g., earthquakes, tsunamis, and volcanoes), weather and climate (e.g., floods, hurricanes, and wildfires), and extra-terrestrial (e.g., meteorite impacts and gamma-ray bursts). Focus on understanding hazard vs risk, recurrence intervals, probabilistic forecasting, and local vs. regional vs. global scale catastrophic events. Generally offered: Fall. This course has Differential Tuition. Course Fee: GS01 $90.

GEO 5454. Advanced Paleontology. (3-3) 4 Credit Hours.
Prerequisite: GEO 3063 or consent of instructor. In-depth paleontological analyses. Current literature and scientific deliberations will be emphasized. Topic 1: Focused Paleontology. Detailed study of one to three taxonomic groups. Topic 2: Paleoecology. Study of fossil organisms in relation to their past environments, and their interactions in extinct ecological communities. Topic 3: Micropaleontology. Study of microscopic fossil organisms that commonly produced a fossil record. Emphasis on taxonomy, evolution, and processing methods. May be repeated for credit when topics vary. Field trips may be required. This course has Differential Tuition. Course Fee: GS01 $120.

GEO 5483. Environmental Hydrogeology. (3-0) 3 Credit Hours.
Focuses on the physical and chemical processes that control natural variation in the chemical and isotopic composition of groundwater, fate and transport of groundwater contaminants, and modeling of groundwater quality using publicly available computer programs. Field trips may be required. This course has Differential Tuition. Course Fee: GS01 $90.

GEO 5504. Subsurface Stratigraphy. (3-3) 4 Credit Hours.
Prerequisite: GEO 3123 and GEO 3131, or consent of instructor. This course includes analysis of seismic and well log data using professional software to understand and constrain the stratigraphic architecture of sedimentary deposits in the subsurface, which is fundamental for the prediction of natural resources (e.g., water, hydrocarbons, rare metals). Field trips may be required. This course has Differential Tuition. Course Fee: GS01 $120.

GEO 5593. Geomicrobiology. (3-0) 3 Credit Hours.
Prerequisite: GEO 1103, GEO 1111, GEO 1103, CHE 1121, and MAT 1093. The course is divided into three units: (1) Fundamentals of Geomicrobiology. Here you will learn about the basic properties of microbes, how we characterize them, and how they function. We will also discuss the major biogeochemical cycles. This portion of the course will lay the foundation for learning about microbial interactions with geological environments. (2) Influence of geological environments on microorganisms. This portion of the course examines environmental controls that influence who exists within microbial communities and what kinds of reactions they carry out. We will emphasize use of thermodynamic calculations to analyze microbial communities and predict behavior. (3) Impacts of microbial activity on geological environments. We will begin this portion of the course with an overview of ways microbes impact their environments and then focus our discussion on impacts of microbial activity on water resources. Generally offered Fall. This course has Differential Tuition. Course Fee: GS01 $90.

GEO 5603. Physical Hydrogeology. (3-0) 3 Credit Hours.
Prerequisite: GEO 4623 with a grade of "C-" or better, or consent of instructor. Geologic principles governing the flow of subsurface water with an emphasis on physical hydrogeology, interaction of surface and groundwater, hydrogeologic properties and their measurement, flow in the unsaturated zone, mass transport, evolution of aquifer systems, and an introduction to groundwater modeling. Field trips may be required. This course has Differential Tuition. Course Fee: GS01 $90.

GEO 5604. Chemical Hydrology. (3-3) 4 Credit Hours.
Prerequisite: GEO 3373 or GEO 4623, or consent of instructor. Discussion of the basic chemical principles of the water cycle, as well as environmentally relevant applications based on case studies. Detailed Groundwater Hydrogeochemistry, Surface Water Hydrogeochemistry, Surface water and Groundwater Interaction - Geochemical Principles governing, Quantitative and Modeling analysis and geologic effects on quality and flow of groundwater. Coverage of contemporary global issues related to water resources, including pollution control, environmental rehabilitation, sustainable development, and global warming exploration of anthropogenic. Topics include land-atmosphere interactions, movement of water and water-rock interaction, and contaminant transport in ground water systems. ASBOG Test Syllabus and web-based teaching are followed. This course has Differential Tuition. Course Fee: GS01 $120.

GEO 5713. Groundwater Modeling. (3-0) 3 Credit Hours.
Prerequisite: GEO 5603 or consent of instructor. Focus is on using MODFLOW code to model the occurrence and movement of groundwater. Course will discuss hydrogeologic data for modeling, modeling protocol, and MODFLOW packages. Multiple graphics-rich user model interfaces commonly used in groundwater science will be learned. Other computer programs for simulating flow of subsurface fluids may be included. This course has Differential Tuition. Course Fee: GS01 $90.

GEO 5723. Biogeochemical Modeling. (3-0) 3 Credit Hours.
Prerequisite: GEO 1103, GEO 1111, GEO 3373, GEO 4203, CHE 1103, CHE 1121, and MAT 1093. In addition to the development of conceptual models, this course uses hands-on practice using Microsoft Excel spreadsheet, several open-source geochemical modeling programs (e.g., PHREEQC, Visual MINTEQ), as well as a commercially available Geochemist's Workbench program that is used over 1,000 universities and research facilities worldwide. Examples of topics covered in this course include microbial activity, surface chemistry, and redox chemistry within reaction models. This course is designed for undergraduate and graduate students in the fields of geochemistry, environmental engineering, contaminant hydrology, geomicrobiology, and numerical modeling. Generally offered Spring. This course has Differential Tuition. Course Fee: GS01 $90.

GEO 5803. Planetary Geology. (3-0) 3 Credit Hours.
Prerequisite: PHY 1963 or consent of instructor. This course is designed for students in the Sciences or Engineering and no prior Geological knowledge is assumed, although Earth will be our point of reference. Survey of the interior and surface geology of solid bodies in our Solar System and beyond (planets, moons, asteroids, comets, Kuiper Belt Objects and exoplanets). Topics will include bulk composition and differentiation of planetary interiors, surface processes such as (cryo-)volcanism and meteorite impacts, erosion and sedimentation by fluids and wind, and heat transfer styles. There will be an emphasis on how we know things and what we do not know, quantifying uncertainties in measurements and models, and the nature of planetary scientific inquiry. This course has Differential Tuition. Course Fee: GS01 $90.

GEO 5894. Advanced Structural Geology. (3-3) 4 Credit Hours.
Prerequisite: GEO 3103 and GEO 3111, or consent of instructor. In-depth study of the various aspects of structural geology: stress and strain, behavior of materials, failure criteria, fault analysis, rheological properties of geologic materials, fold analysis, and subsurface analysis. Field trips may be required. This course has Differential Tuition. Course Fee: GS01 $120.

GEO 5904. Carbonate Petrology. (3-3) 4 Credit Hours.
Prerequisite: GEO 3043, GEO 3051, GEO 3123, and GEO 3131, or consent of instructor. This course includes thin-section analysis and hand-specimen study of carbonate sediment and rocks, carbonate classifications, carbonate facies, models, and carbonate diagenesis using advanced microscopic tools and cutting-edge analytical techniques. Field trips may be required. This course has Differential Tuition. Course Fee: GS01 $120.

GEO 5954. Sandstone Petrology. (3-3) 4 Credit Hours.
Prerequisite: GEO 3043, GEO 3051, GEO 3123, and GEO 3131, or consent of instructor. This course covers thin-section analysis and hand-specimen study of clastic rocks, classifications, interpretation of provenance, clastic sedimentary facies, and clastic diagenesis using advanced microscopic tools and cutting-edge analytical techniques. Field trips may be required. This course has Differential Tuition. Course Fee: GS01 $120; LRS1 $61.60; STSI $28.80.

GEO 5971. Directed Research. (0-0) 1 Credit Hour.
Prerequisites: Graduate standing and permission in writing (form available) from the instructor and the student's Graduate Advisor of Record. The directed research course may involve a laboratory, field-based, or theoretical problem. May be repeated for credit, but not more than 6 hours, regardless of discipline, will apply to the Master's degree. This course has Differential Tuition. Course Fees: GS01 $30.

GEO 5972. Directed Research. (0-0) 2 Credit Hours.
Prerequisite: Graduate standing and permission in writing (form available) from the instructor and the student's Graduate Advisor of Record. The directed research course may involve a laboratory, field-based, or theoretical problem. May be repeated for credit, but not more than 6 hours, regardless of discipline, will apply to the Master's degree. This course has Differential Tuition. Course Fee: GS01 $60.

GEO 5973. Directed Research. (0-0) 3 Credit Hours.
Prerequisite: Graduate standing and permission in writing (form available) from the instructor and the student's Graduate Advisor of Record. The directed research course may involve a laboratory, field-based, or theoretical problem. May be repeated for credit, but not more than 6 hours, regardless of discipline, will apply to the Master's degree. This course has Differential Tuition. Course Fee: GS01 $90.

GEO 5991. Graduate Seminar in Geosciences. (1-0) 1 Credit Hour.
Prerequisite: Graduate standing in geosciences or consent of the Graduate Advisor of Record. Topical issues chosen by faculty and current research seminars presented by faculty, visiting lecturers, and Master's degree candidates. May be repeated for credit but only 2 hours may be applied toward the Master's degree. The grade report for the course is either "CR" (satisfactory performance) or "NC" (unsatisfactory performance). This course has Differential Tuition. Course Fee: GS01 $30.

GEO 6011. Seminar in Geospatial Science and Applications. (1-0) 1 Credit Hour.
Seminar will focus on literature review of cutting-edge research in remote sensing, GIS, geoinformatics, and their applications to water resources, surface hydrology and cryosphere. This course has Differential Tuition. Course Fee: GS01 $30.

GEO 6021. Welcome to the Anthropocene. (1-0) 1 Credit Hour.
A reading seminar to understand how the Anthropocene and its collateral concepts (e.g., planetary boundaries) have become ubiquitous denominations to encompass all the consequences of human impacts on the global environment. Select theoretical and applied case studies from the peer-review literature will be analyzed in order to understand the implications for Geoscience practitioners. This course has Differential Tuition. Course Fee: GS01 $30.

GEO 6031. Ethical Conduct of Graduate Research. (1-0) 1 Credit Hour.
This course engages students in activities that explore ethical issues involved in conducting research at the graduate level and developing a thesis or dissertation. Topics covered include organizational and time management skills, data archiving, scientific honesty, technical writing, plagiarism, and dissemination issues. This course has Differential Tuition. Course Fee: GS01 $30.

GEO 6043. Global Change. (3-0) 3 Credit Hours.
Prerequisite: Graduate standing in the program or consent of instructor. Changes in the global distribution of plants and animals and the causes of the changes will be examined. Factors that are apparently coupled to changes in the atmosphere and environmental temperature will be examined. (Same as CE 6113 and ES 5043. Formerly GEO 5043. Credit can be earned for only one of the following: CE 6113, ES 5043, GEO 5043, or GEO 6043.) This course has Differential Tuition. Course Fee: GS01 $90.

GEO 6053. Remote Sensing. (2-3) 3 Credit Hours.
Prerequisite: MAT 1073, and PHY 1603 or PHY 1943. Fundamental remote sensing theory and technology will be introduced and emphasized as well as remote sensing applications to land surface, ocean, and atmosphere. Emphasis will be on the interaction of electromagnetic energy with the Earth's surface and different types of remote sensing for data collection. (Formerly GEO 5053. Credit cannot be earned for both GEO 5053 and GEO 6053.) This course has Differential Tuition. Course Fee: GS01 $90.

GEO 6083. Remote Sensing Image Processing and Analysis. (2-3) 3 Credit Hours.
Prerequisite: GEO 4093 or GEO 6053, or consent of instructor. Fundamentals, algorithms, and techniques of remote sensing image processing, information extraction and analysis, including radiometric and geometric corrections, image enhancement, image sharpening, principal components analysis, image classification, spectral analysis, vectorization, integration with GIS, etc. (Formerly GEO 5083. Credit cannot be earned for both GEO 5083 and GEO 6083.) This course has Differential Tuition. Course Fee: GS01 $90; LRS1 $46.20; STSI $21.60.

GEO 6093. Remote Sensing in Hydrology. (2-3) 3 Credit Hours.
Prerequisite: GEO 4093 or GEO 6053, or consent of instructor. Apply remote sensing to derive parameters of surface hydrology and hydrometeorology such as precipitation, land surface temperature and emissivity, heat flux, evaporation, evapotranspiration, soil moisture, surface water, water quality, snow and ice, and soil erosion. The contents will also include radar hydrology, microwave techniques and mapping of soil moisture and precipitation, and remote sensing in hydrologic modeling. (Formerly GEO 5093. Credit cannot be earned for GEO 5093 and GEO 6093.) This course has Differential Tuition. Course Fee: GS01 $90.

GEO 6183. Basin Analysis and Sedimentary Geology. (3-0) 3 Credit Hours.
An interdisciplinary integration of geodynamics, mathematical and physical modeling, and sedimentary geology. Emphasizes basin formation, nature and maturation of the basin fill, and timing of events. Case histories of various basins illustrate approaches. Field trips may be required. This course has Differential Tuition. Course Fee: GS01 $90; LRS1 $46.20; STSI $21.60.

GEO 6193. Stratigraphy and Sedimentology Applied to Geological Problems. (3-0) 3 Credit Hours.
Prerequisite: Either GEO 5504, GEO 5904, GEO 5954, or consent of instructor. Study of the use of stratigraphy and sedimentology in various subfields of the geoscience workforce (e.g., water sustainability and quality, hydrocarbon exploration, carbon sequestration, rare metals mining, environmental assessment), based on a review of fundamental principles and of case studies, on the application of these principles to real-world datasets, and on interactions with professionals in these subfields. Field trip may be required. This course has Differential Tuition. Course Fee: GS01 $90.

GEO 6304. Isotope Geochemistry. (3-3) 4 Credit Hours.
Prerequisite: GEO 3373. The course will cover an introduction to isotope theory, and its utility in geological science and related fields. Focus will be on methods, data acquisition, data corrections, and interpretation. Laboratory methods for isotope sample preparation and hands-on experience with isotope ratio-mass spectrometry (IRMS) and peripherals. This course has Differential Tuition. Course Fee: GS01 $120; LRS1 $61.60; STSI $28.80.

GEO 6403. Advanced Geophysics. (3-0) 3 Credit Hours.
Prerequisite: GEO 3383 or consent of instructor. Application of fundamentals of geophysical properties of the earth, specifically the propagation of seismic energy and electromagnetic (EM) fields in earth materials, toward an advanced analysis of seismic, EM prospection techniques, and well-logging methods. Techniques addressed will be specifically relevant to the petroleum and mineral extraction industries. This course has Differential Tuition. Course Fee: GS01 $90.

GEO 6513. Advanced GIS. (2-3) 3 Credit Hours.
Prerequisite: CE 5093 or GEO 5033, or consent of instructor. Geographic Information Systems (GIS) is an excellent tool for modeling, analyzing, and managing environmental systems. This course teaches advanced concepts and applications of industry standard GIS software, including spatial analysis, spatial statistics, geostatistical analysis, 3-D analysis, and geoprocessing. The emphasis of this course is on understanding the underlying principles of those tools and on how to apply them to solve real-world problems. This course has Differential Tuition. Course Fee: GS01 $90.

GEO 6523. GIS for Water Resources. (3-0) 3 Credit Hours.
Prerequisite: GEO 4623 and GEO 6513, or consent of instructor. Current approaches for using GIS to acquire, process and analyze spatial data for surface water and groundwater systems. Course will introduce watershed delineation techniques, spatial interpolation methods for analysis of precipitation and groundwater data, and GIS-based modeling of hydrologic mass-balance in watersheds. This course has Differential Tuition. Course Fee: GS01 $90.

GEO 6533. Programming for Geospatial Application. (2-3) 3 Credit Hours.
Prerequisite: CE 5093 or GEO 5033, or consent of instructor. This course teaches one or more programming languages with high-level toolkits suitable for GIS (Geographic Information System) application and development in a variety of open source environments. The course introduces key GIS concepts such as location, distance, units, projections, datum, and GIS data formats, examines a number of libraries of programming languages (e.g., Python or others), and explores how to combine these with geo-spatial data to accomplish a variety of tasks. This course has Differential Tuition. Course Fee: GS01 $90.

GEO 6543. Web GIS. (2-3) 3 Credit Hours.
Prerequisite: ES 2113, GEO 2113, or GEO 3343; and GEO 5033, or consent of instructor. This course will focus upon developing GIS applications to be served out via the Internet or a local Area Network (LAN). Additional topics include the use of Web authoring software. The course presents and introductory level skill set for the creation and publishing of Web mapping applications using the ESRI ArcGIS Online resources and available tools. (Formerly EES 6543. Credit cannot be earned for both EES 6543 and GEO 6543.) This course has Differential Tuition. Course Fee: GS01 $90; LRS1 $46.20; STSI $21.60.

GEO 6623. Rheology of Earth Materials. (3-0) 3 Credit Hours.
Prerequisite: PHY 1963 or consent of instructor. This course is designed for graduate students in the Sciences or Engineering and no prior Geological knowledge is assumed. Survey of the rheological behavior of solid Earth materials (rocks and ices) and fluids (brines, hydrocarbons, magma and lava). The course will include empirical and thermodynamic models for the viscosity of fluids, three-phase suspension rheology (solid+liquid+gas), and statistical fitting of experimental data. Examples of applied rheology will include lava flows and the deformation of continents, and various foods will be studied as analog materials. This course has Differential Tuition. Course Fee: GS01 $90.

GEO 6813. Water Resources. (3-0) 3 Credit Hours.
Application of management principles to the efficient use of water resources by people and their public and private institutions. Water is examined in terms of its value, use, and changing role in the context of economics, history, politics, and technology. This course has Differential Tuition. Course Fee: GS01 $90.

GEO 6951. Independent Study. (0-0) 1 Credit Hour.
Prerequisite: Graduate standing and permission in writing (form available) from the instructor and the student's Graduate Advisor of Record. Independent reading, research, discussion, and/or writing under the direction of a faculty member. For students needing specialized work not normally or not often available as part of the regular course offerings. May be repeated for credit, but not more than 6 hours, regardless of discipline, will apply to the Master's degree. This course has Differential Tuition. Course Fee: GS01 $30.

GEO 6952. Independent Study. (0-0) 2 Credit Hours.
Prerequisite: Graduate standing and permission in writing (form available) from the instructor and the student's Graduate Advisor of Record. Independent reading, research, discussion, and/or writing under the direction of a faculty member. For students needing specialized work not normally or not often available as part of the regular course offerings. May be repeated for credit, but not more than 6 hours, regardless of discipline, will apply to the Master's degree. This course has Differential Tuition. Course Fee: GS01 $60.

GEO 6953. Independent Study. (0-0) 3 Credit Hours.
Prerequisite: Graduate standing and permission in writing (form available) from the instructor and the student's Graduate Advisor of Record. Independent reading, research, discussion, and/or writing under the direction of a faculty member. For students needing specialized work not normally or not often available as part of the regular course offerings. May be repeated for credit, but not more than 6 hours, regardless of discipline, will apply to the Master's degree. This course has Differential Tuition. Course Fee: GS01 $90.

GEO 6961. Comprehensive Examination. (0-0) 1 Credit Hour.
Prerequisite: Approval of the appropriate Graduate Program Committee to take the Comprehensive Examination. Independent study course for the purpose of taking the Comprehensive Examination. May be repeated as many times as approved by the Graduate Program Committee. Enrollment is required each term in which the Comprehensive Examination is taken if no other courses are being taken that term. The grade report for the course is either "CR" (satisfactory performance on the Comprehensive Examination) or "NC" (unsatisfactory performance on the Comprehensive Examination). This course has Differential Tuition. Course Fee: GS01 $30.

GEO 6973. Special Problems. (3-0) 3 Credit Hours.
Prerequisite: Consent of instructor. An organized course offering the opportunity for specialized study not normally or not often available as part of the regular course offerings. Special Problems courses may be repeated for credit when the topics vary, but not more than 6 hours, regardless of discipline, will apply to a Master's degree. Field trips may be required. This course has Differential Tuition. Course Fee: GS01 $90.

GEO 6981. Master's Thesis. (0-0) 1 Credit Hour.
Prerequisite: Permission from the Graduate Advisor of Record and thesis director. Thesis research preparation. May be repeated for credit, but not more than 6 hours will apply to the Master's degree. Credit will be awarded upon completion of the thesis. Enrollment is required each term in which the thesis is in progress. This course has Differential Tuition. Course Fee: GS01 $30.

GEO 6982. Master's Thesis. (0-0) 2 Credit Hours.
Prerequisite: Permission from the Graduate Advisor of Record and thesis director. Thesis research preparation. May be repeated for credit, but not more than 6 hours will apply to the Master's degree. Credit will be awarded upon completion of the thesis. Enrollment is required each term in which the thesis is in progress. This course has Differential Tuition. Course Fee: GS01 $60.

GEO 6983. Master's Thesis. (0-0) 3 Credit Hours.
Prerequisite: Permission from the Graduate Advisor of Record and thesis director. Thesis research preparation. May be repeated for credit, but not more than 6 hours will apply to the Master's degree. Credit will be awarded upon completion of the thesis. Enrollment is required each term in which the thesis is in progress. This course has Differential Tuition. Course Fee: GS01 $90.

GEO 7211. Doctoral Research. (0-0) 1 Credit Hour.
Prerequisite: Admission to candidacy for the Doctoral degree. May be repeated for credit, but no more than 15 hours may be applied to the Doctoral degree. This course has Differential Tuition. Course Fee: GS01 $30.

GEO 7212. Doctoral Research. (0-0) 2 Credit Hours.
Prerequisite: Admission to candidacy for the Doctoral degree. May be repeated for credit, but no more than 15 hours may be applied to the Doctoral degree. This course has Differential Tuition. Course Fee: GS01 $60.

GEO 7213. Doctoral Research. (0-0) 3 Credit Hours.
Prerequisite: Admission to candidacy for the Doctoral degree. May be repeated for credit, but no more than 15 hours may be applied to the Doctoral degree. This course has Differential Tuition. Course Fee: GS01 $90.

GEO 7311. Doctoral Dissertation. (0-0) 1 Credit Hour.
Prerequisite: Admission to candidacy for the Doctoral degree. May be repeated for credit, but no more than 15 hours may be applied to the Doctoral degree. This course has Differential Tuition. Course Fee: GS01 $30.

GEO 7312. Doctoral Dissertation. (0-0) 2 Credit Hours.
Prerequisite: Admission to candidacy for the Doctoral degree. May be repeated for credit, but no more than 15 hours may be applied to the Doctoral degree. This course has Differential Tuition. Course Fee: GS01 $60.

GEO 7313. Doctoral Dissertation. (0-0) 3 Credit Hours.
Prerequisite: Admission to candidacy for the Doctoral degree. May be repeated for credit, but no more than 15 hours may be applied to the Doctoral degree. This course has Differential Tuition. Course Fee: GS01 $90.